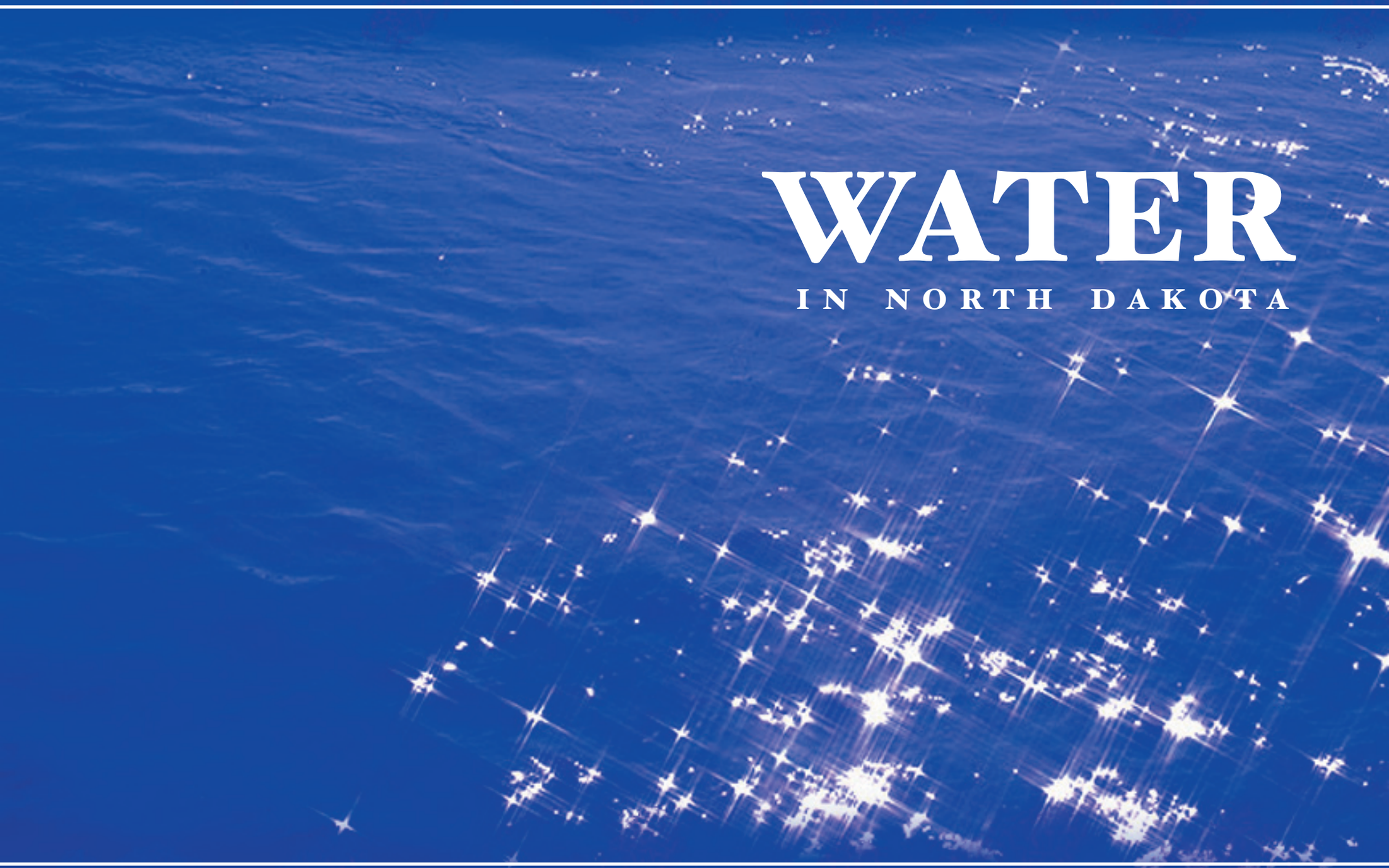
A REFERENCE GUIDE

WATER
IN NORTH DAKOTA



North Dakota State Water Commission
900 East Boulevard Avenue
Bismarck, ND 58505

North Dakota State Water Commission

June 2005

Dear Friends,

Though difficult to imagine, water impacts every aspect of every person's life, every single day. And without question, every drop on earth is a gift, not to be taken for granted. Thus, to maintain a level of awareness where the value of water is truly recognized, it is important to understand the nature of our water resources; particularly those right here in North Dakota.

This publication, which has been updated from a previous version, was originally developed with that purpose in mind— to provide updated, general information about North Dakota's surface, ground, and atmospheric water resources. In short, I believe it provides an excellent educational tool for anyone interested in learning more about North Dakota's water resources, from a statewide, or major drainage basin perspective.

I am hopeful that this publication will not only serve you as an excellent learning tool, but that it will also instill within you a greater respect for our most precious natural resource— water. With that, I am happy to present to you this updated reference guide to water in North Dakota.

Best regards,

Dale L. Frink

Dale L. Frink, P.E.
State Engineer

A REFERENCE GUIDE

WATER

IN NORTH DAKOTA

Presented by
the NORTH DAKOTA STATE WATER COMMISSION
900 East Boulevard Avenue
Bismarck, ND 58505
(701) 328-2750

Governor John Hoeven, Chairman
Dale L. Frink, State Engineer

2005

Statewide

Description

• North Dakota covers 70,702 square miles in a rectangular area at the center of the North American continent. Two percent, or 1,403 square miles of the state's surface area is covered by water.

• The width of the state from north to south is 210 miles. The length of the state is 310 miles at the northern boundary and 360 miles at the southern boundary.

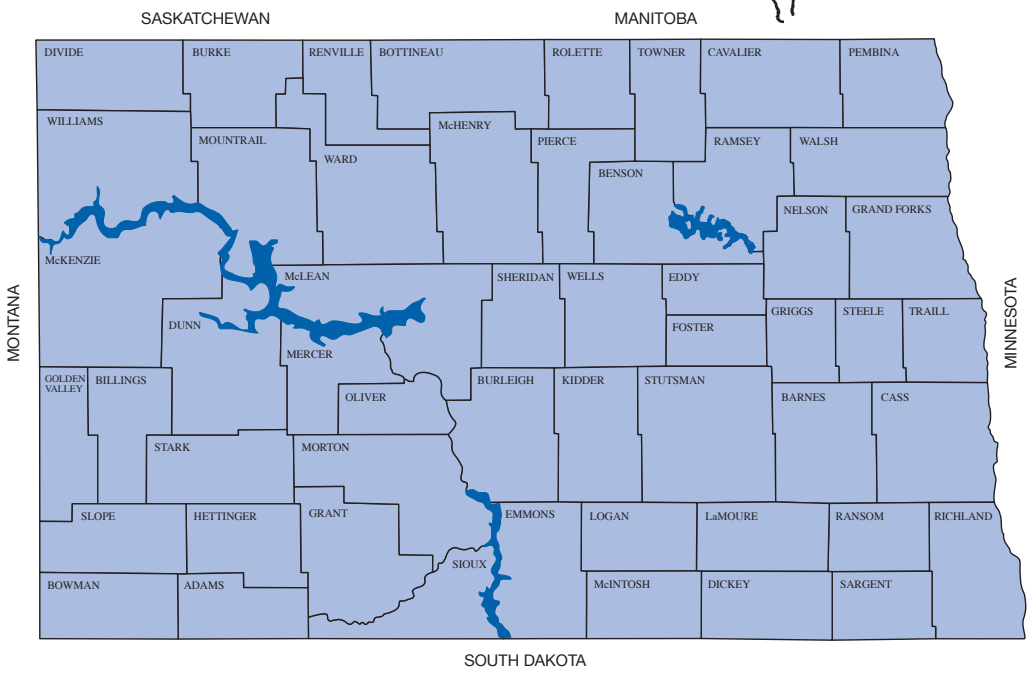
• Elevations range from about 730 feet above mean sea level (amsl) in the northeast corner of the state to 3,506 feet amsl in the southwest.

• The state is bordered to the north by two Canadian provinces– Manitoba and Saskatchewan; to the east– Minnesota; to the south– South Dakota; and to the west– Montana.

• In 2000, North Dakota's estimated population was 642,200 of which 76 percent was urban and 24 percent was rural.

• North Dakota's economy is based primarily on agriculture, manufacturing, tourism, and mining. Mining includes: non-fuel minerals, lignite coal, and the extraction of petroleum and natural gas.

• North Dakota's total mineral production was valued at $1.7 billion on 2003. Petroleum and natural gas extraction accounted for $1.1 billion, lignite for $584 million, and non-fuel minerals for $38 million of the total value.



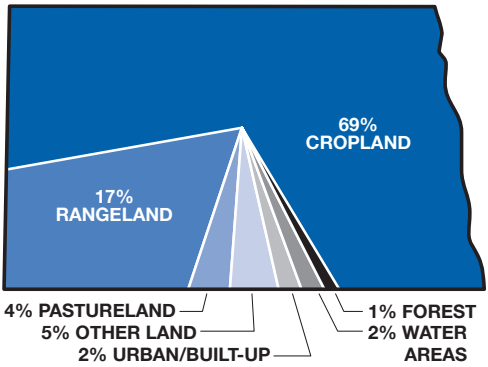
• Agriculture is North Dakota's primary industry. In 2003, production agriculture generated more than $4.4 billion in cash receipts (including government payments).

• Value-added ag processing and farm input manufacturing generate $1.7 billion in business activity per year.

• Water-based recreation, available at rivers, lakes, and reservoirs, is extremely important to the state's tourism industry.

• About 90 percent of the land use in the state is associated with agriculture.

LAND USE IN NORTH DAKOTA



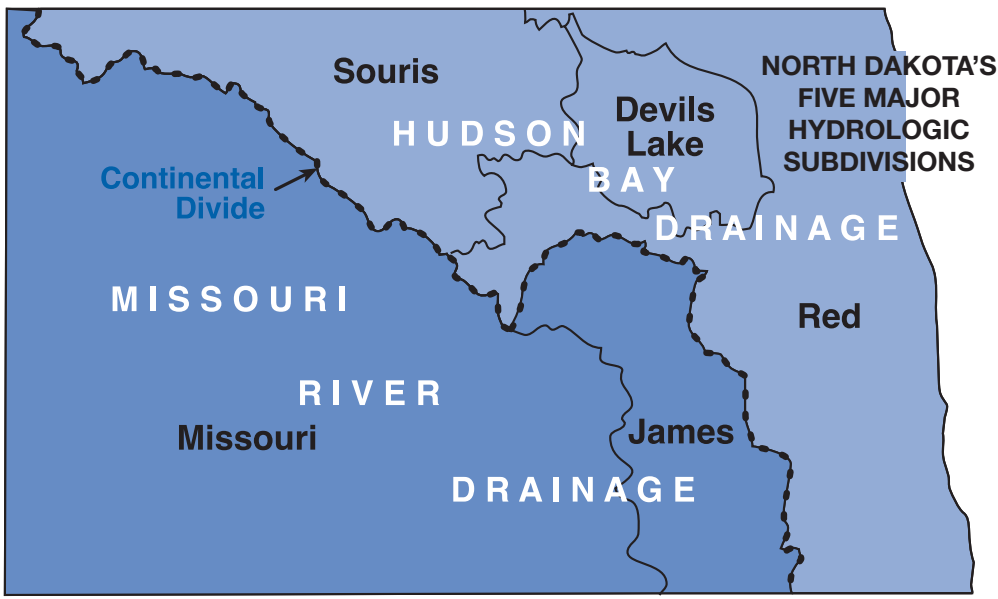
Surface Water

• The state of North Dakota is separated into two major drainage basins by a continental divide running from the northwest through the central and southeastern part of the state. The northeastern portion of the state falls generally within the Hudson Bay drainage, while the southwestern part is drained by the Missouri River into the Gulf of Mexico.

• The Missouri River drainage basin in North Dakota includes the major subbasins of the Missouri and James Rivers. The area is characterized by a combination of glaciated terrain, with badlands and landforms of eroded, soft, sedimentary bedrock in the southwest. The badlands are the colorful cliffs, canyons, gorges, ravines, and gullies that have been created by extensive wind and water erosion.

• The Hudson Bay drainage basin includes the Souris and Red River systems plus the large, currently noncontributing, Devils Lake Basin. Glacial landforms and lake plains characterize this region of the state.

• There are five major hydrologic subdivisions in North Dakota: the Missouri River Basin, the James River Basin, the Red



River Basin, the Devils Lake Basin, and the Souris River Basin.

• The climate in North Dakota is sub-humid continental, characterized by highly variable daily, seasonal, and annual weather patterns. Annual mean precipitation in the state ranges from 13 inches in the northwest to more than 20 inches in the extreme east and southeast. An example of historical extreme precipitation fluctuation can be seen in the charts on this page.

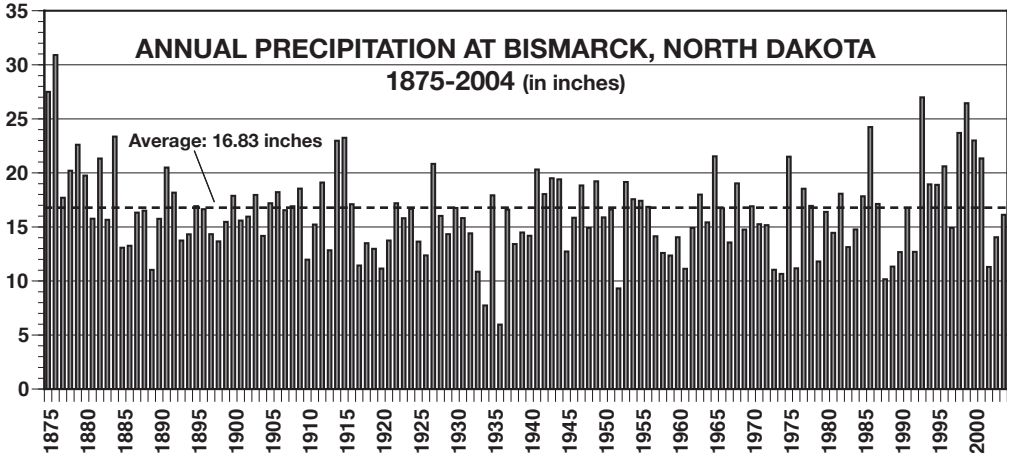
• Flow in all streams is seasonally quite variable. Runoff is often the greatest in early spring as a result of snowmelt water and spring rainfall. Many of the smaller streams experience little or no flow for extended periods during the drier summer months.

• The significant and sometimes dramatic flow variations that can occur in river discharges throughout the years are caused by climatic conditions, precipitation amounts, evaporation rates and snow pack conditions.

• The major rivers and their tributaries total approximately 5,100 river miles.

STATEWIDE PRECIPITATION RECORDS

	TIME	PLACE	AMT	DATE
HIGH	24hrs.	McKinney	7.70	June 15, 1897
	1 mo.	Mohall	14.01	June 1944
	1 yr.	Milnor	37.98	1944
LOW	1 yr.	Parshall	4.02	1934



STREAMFLOW RECORDS OF MAJOR RIVERS OR STREAMS OF THE FIVE BASINS

River	Measuring Location	Ave. Daily Discharge	Discharge (CFS)[1] Maximum	Minimum	Annual Runoff (AF)[2]
Missouri	Bismarck[3]	22,680.0	68,800	4,000.0	16,430,000
Red	Drayton	4,393.0	124,000	110.0	3,183,000
Souris	Westhope	269.0	12,400	0	194,000
James	LaMoure	163.0	6,420	0	118,000
Mauvais Coulee (Devils Lake Basin)	Cando	19.7	2,980	0	14,260

[1]Cubic feet per second: the rate of flow representing a volume of a cubic foot passing a given point during a second; equals 448.8 gallons per minute.
[2]Acre-foot: the amount of water that will cover an acre of land a foot deep; equals 325,851 gallons.
[3]Records for post-completion of Garrison Dam.

• Lakes and reservoirs total nearly 863,000 acres.

• Seven lakes and reservoirs (greater than 5,000 acres each) comprise a total of 520,000 acres.

• A comparison of relative discharges of the major rivers is depicted by the figure below.

• The total combined annual flow of the Red River at Fargo, the Sheyenne River at Valley City, the James River at Jamestown, and the Souris River at Minot is about 4 percent of the annual flow of the Missouri River at Bismarck.

• There are approximately 2.5 million acres classified as wetlands in the state.

• Reservoirs are extremely important to outdoor recreation, providing 87 percent of the water surface acres available for fishing and other recreational users.

• Normal reservoir storage in 927 reservoirs (50 acre-feet or more) in the state totals 19.3 million acre-feet (AF), while maximum storage capacity is 27.1 million AF.

• Ninety-seven percent to total normal reservoir storage in the state is within Lake Sakakawea and Lake Oahe.

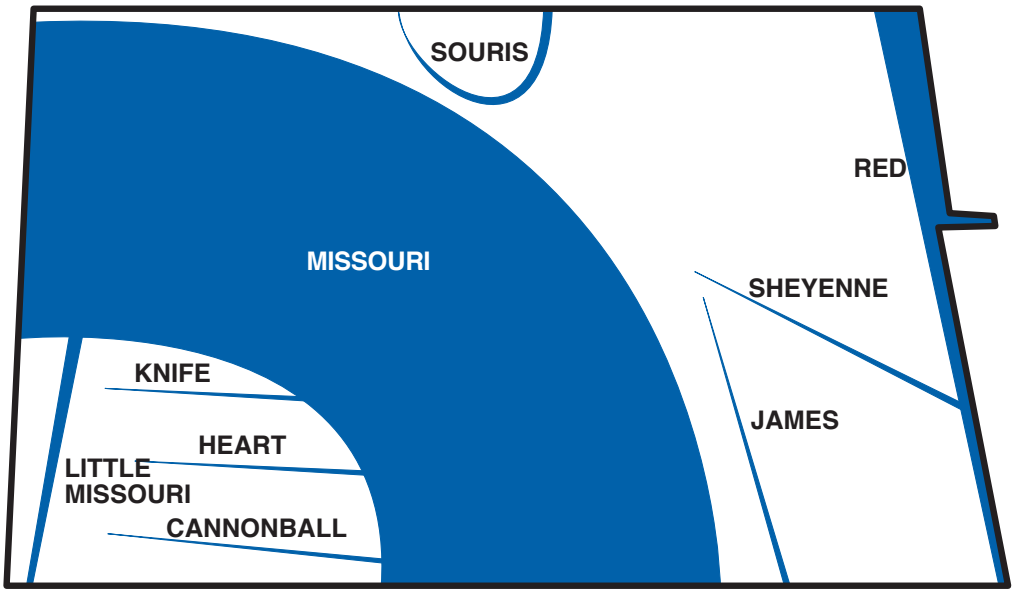
• Surface water quality in North Dakota is quite variable and influenced by climatic conditions, land use, erosion, and shallow ground water discharged from springs. Increased stream flows, associated with snowmelt and precipitation, generally cause a decrease in dissolved solids and an increase in suspended sediment; the reverse is common during normal or low flow conditions.

• The Missouri River has the best water quality of any stream in the state.

• Of the 18 communities using surface water as their municipal water supply, no primary water quality standards (associated with health problems) are exceeded; however, the water in one community exceeds secondary water quality standards (associated with aesthetic problems).

• In North Dakota 2.5 million acres (6 percent of the state's total area) are located in floodplain areas.

RELATIVE DISCHARGES OF THE PRINCIPAL RIVERS IN NORTH DAKOTA



•Throughout the state, 168 of the 365 incorporated communities participate in the National Flood Insurance Program (NFIP). In addition, 42 counties and 78 townships also participate in the NFIP.

• Of the state's population, 5 percent, or about 32,000 people live in floodplain areas.

Ground Water

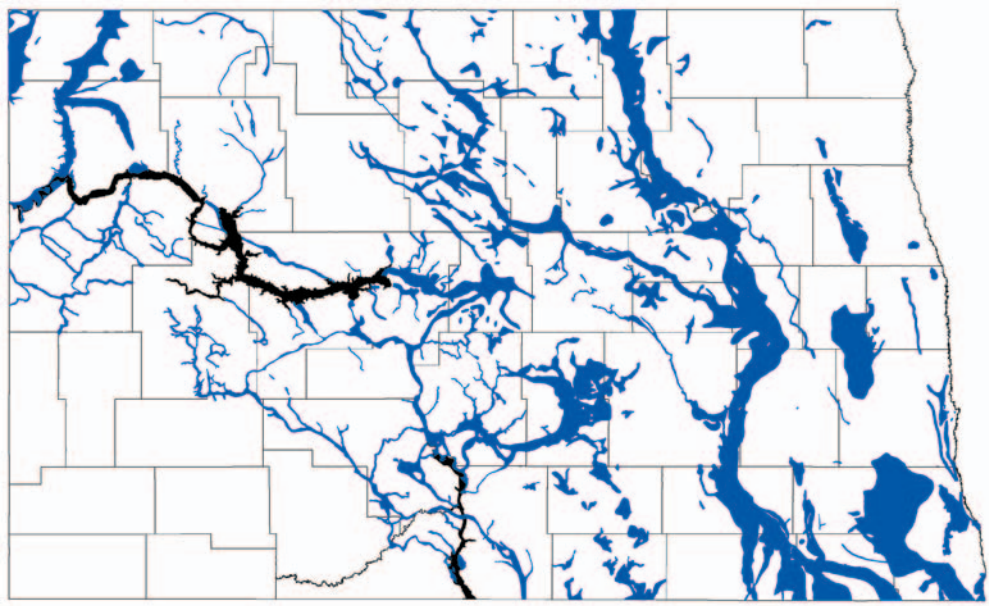
• Ground water underlies the land surface throughout all of North Dakota. Ground water generally occurs in two major types of rock– unconsolidated deposits and bedrock. Unconsolidated deposits are loose beds of gravel, sand, silt, or clay of glacial origin. Bedrock consists primarily of shale and sandstone. With the exception of southwestern North Dakota, bedrock underlies the unconsolidated deposits. Saturated deposits that are sufficiently permeable to readily transmit water are called aquifers. Aquifers in the unconsolidated deposits (also called glacial drift aquifers) are the result of glacial outwash deposits. These aquifers are generally more productive than aquifers found in the underlying bedrock. Bedrock aquifers underlie the entire state and tend to be more continuous and widespread than aquifers in the unconsolidated deposits.

• It is estimated that 60 million AF of water are stored in the major unconsolidated aquifers in the state. The amount of water available in the bedrock aquifers is unknown.

• Water quality of the state's aquifers varies greatly and in many areas is marginal. Water in the unconsolidated aquifers is generally less mineralized than water in deeper bedrock aquifers, which is typically more saline.

• Of the 178 communities with municipal distribution systems relying on ground water for their water supply, two communities exceed primary water quality standards and 149 exceed secondary water quality standards.

MAJOR GLACIAL DRIFT AQUIFERS IN NORTH DAKOTA



Atmospheric Water

• There are currently portions of six counties participating in the Cloud Modification Project. The purpose of the project is to suppress hail and increase rainfall.

• In wet years, 62 to 90 million AF of water falls on the state as precipitation, while in dry years the amount is reduced to 30 to 60 million AF.

• On a typical summer thunderstorm day, about 7 million AF of water passes over North Dakota in the form of invisible water vapor.

• In the atmosphere, water seldom freezes right at 32° (0° C), but instead supercools, often to subzero (0°F) temperatures before forming ice crystals.

• By far the greatest source of atmospheric water over North Dakota is the Gulf of Mexico, not the Pacific Ocean. The contribution of Lake Sakakawea is relatively minor.

• Most northern Great Plains precipitation, even from summer thunderstorms, originates as ice within clouds miles above the surface, where typical temperatures range from 0° to -50°F.

• In a typical developing North Dakota summertime cloud, one cubic inch contains about 16,000 tiny cloud droplets, each only about .0005 inches in diameter.

• Vast amounts of heat are released when water condenses, and again when it freezes. The scale of this energy release is mind-boggling; an average thunderstorm cell during its 30-minute lifetime liberates about the same energy as a World War II atomic bomb.

Water Use

• North Dakota's total water use in 2003 was 9 percent of the average annual flow of the Missouri River at Bismarck.

• Ninety-four percent of the incorporated communities in the state rely on ground water from private wells, municipal distribution systems, and/or rural water systems.

• Ground water is virtually the sole source of all water used by farm families and residents of small communities having no public water distribution system.

• About 40 percent of the state's population relies on surface water. Most of the major cities are located next to rivers.

• Industry is the major water user in the state. Approximately 77 percent of total water use in North Dakota is for power generation. Of that total, 96 percent is nonconsumptive.

• Almost all water used for thermoelectric and coal gasification purposes is obtained from Lake Sakakawea and the Missouri River.

• Dollars spent on water-based tourism, and recreation play an increasing role in the state's economy. A recent study by North Dakota State University determined the total gross business volume generated by fishing on Lake Sakakawea to be as high as $89 million per year.

• In 2004, 32 rural water systems were providing quality drinking water to 25 percent of the state's population. Over 158,000 residents are served by rural water systems, including 294 cities, 21 subdivisions, and over 90,000 rural residents. Rural water systems range in size from a few hundred connections, to over 2,500 connections. Forty-seven of North Dakota's 53 counties, are served by rural water systems, and most have plans to expand to cover additional areas. The majority of the rural water systems in the state use ground water.

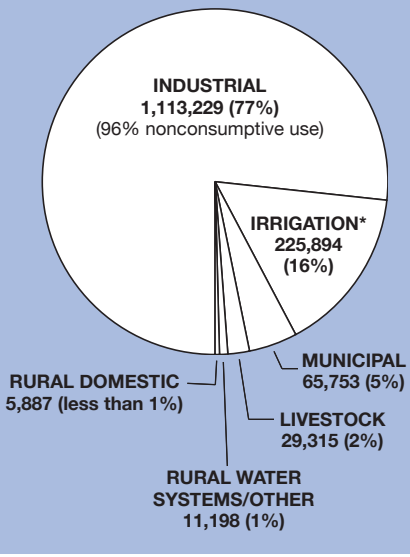
• Sixty-one percent of the ground water used in North Dakota in 2003 was for irrigation.

• Over 6 million acres of North Dakota soils are potentially irrigable.

NOTE: "Non-withdrawal use" of water including recreation, navigation, fish and wildlife, and flood control is substantial in some river basins, but has not been identified in this booklet.

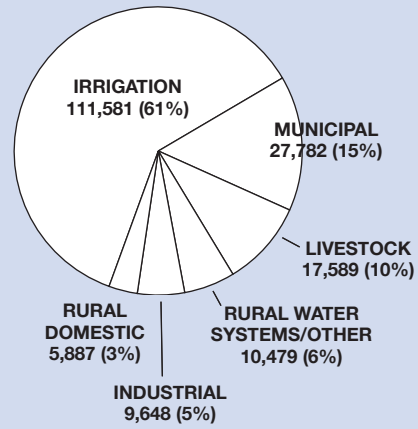
STATEWIDE 2003 WATER USE (in acre-feet)

TOTAL WATER USE

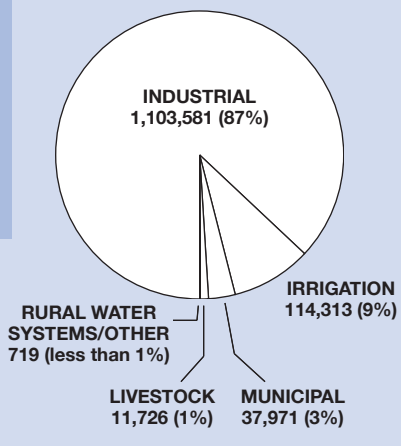


*Includes 26,575 AF of water diverted from the Yellowstone River in Montana to irrigate 17,717 acres of land in North Dakota located along the Montana-North Dakota border.

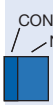
Ground Water Use



Surface Water Use



STATEWIDE WATER USE VS. MISSOURI RIVER FLOW AT BISMARCK



1,451,276 AF - STATEWIDE WATER USE IN 2003

16,480,000 AF - MISSOURI RIVER AVERAGE ANNUAL FLOW

Statewide Concerns

Most of North Dakota's water management problems are common to each basin of the state. Only the degree of severity differs, depending upon the regional topography, geology, climatic conditions, and people's influence upon the natural environment. Examples of problems and concerns are:

• Some of the state's water users have inadequate (quality and/or quantity) water to meet municipal, rural domestic, irrigation, and livestock needs.

• Flooding of agricultural land and urban areas results from heavy runoff of snowmelt and/or heavy rainfall.

• Extended drought has a devastating effect on the state's economy and people. Plans to lessen the severity of drought-related impacts and hardships need to be put in place.

• Soil erosion contributes to sedimentation and accelerates the aging of natural lakes and reservoirs.

• Streambank erosion results in the loss of wildlife habitat, valuable real estate, and contributes to pollution.

• Ground-water contamination, although not widespread, has resulted from industrial sources, agricultural chemicals, and naturally-occurring sources.

• Controversy exists regarding wetland preservation versus agricultural drainage.

• The state lacks a distribution system to move water from the Missouri River to the northwest and eastern portions of the state for various purposes. The Missouri River is a virtually untapped resource that presents a unique opportunity for development and use in the state's future.

• The state will be severely challenged in years ahead to provide revenue to fully implement all projects and programs required to manage and develop the state's water resources.

• Abandoned water wells should be identified and sealed to reduce the potential for ground-water contamination.

• State control versus federal control concerning water resource use and management is a growing concern in North Dakota.

• There is a need for all communities and rural water systems to identify alternative water supplies in case of emergencies including mechanical failure, drought, contamination, or acts of terrorism.

• North Dakota must establish its right to a fair share of Missouri River water.

• Impacts to recreation and fisheries management should be given more emphasis in developing annual operating plans for the Missouri River main stem dams.

• Every effort should be taken to cooperatively quantify Native American and federal water rights.

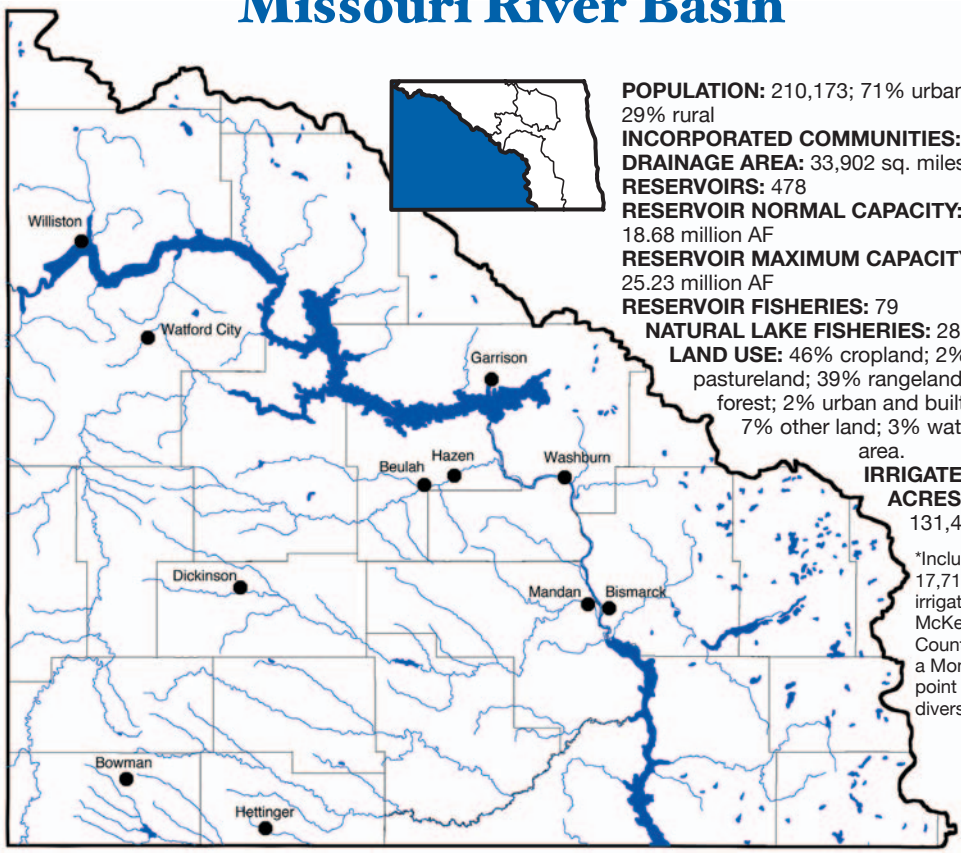
• Wetlands and adjacent habitat should be secured through voluntary programs, which provide incentives to landowners/farm operators, rather than through regulations that require compliance.

• Education efforts involving water resource management issues and concerns must be continued and expanded.

• It is becoming increasingly difficult for communities to comply with new federal drinking water quality standards without costly modifications or improvements to existing treatment facilities.

• Minimum instream flow requirements for fish and wildlife purposes as proposed by environmental interest groups have the potential to place considerable constraints upon other competing water users such as municipal, industrial, and irrigation uses.

Missouri River Basin



POPULATION: 210,173; 71% urban and 29% rural
INCORPORATED COMMUNITIES: 109
DRAINAGE AREA: 33,902 sq. miles
RESERVOIRS: 478
RESERVOIR NORMAL CAPACITY: 18.68 million AF
RESERVOIR MAXIMUM CAPACITY: 25.23 million AF
RESERVOIR FISHERIES: 79
NATURAL LAKE FISHERIES: 28
LAND USE: 46% cropland; 2% pastureland; 39% rangeland; 1% forest; 2% urban and built-up; 7% other land; 3% water area.
IRRIGATED ACRES: 131,463*

*Includes 17,717 acres irrigated in McKenzie County from a Montana point of diversion.

Description

• The Missouri River Basin, comprised of seven major subbasins, is the largest in the state, draining approximately 48 percent of the state's total area. The basin coincides roughly with the portion of the state having a semiarid climate. The tributaries on the south and west sides of the Missouri River typically occupy small but sharply-defined valleys. This area is well drained with very few natural lakes. The topography is characterized by numerous flat-topped, steep-sided buttes and hills. The most prominent are located in the Badlands along the Little Missouri River. The area east of the Missouri River is characterized by numerous small lakes and wetlands. Annual mean precipitation in the basin ranges from 13 inches in the northwest to 17 inches in the east.

• Lake Sakakawea was formed by the closing of Garrison Dam in 1953. Lake Sakakawea normally covers 364,000 surface acres, can store a maximum of 24.2 million AF, and has 1,600 miles of shoreline in six counties. Lake Oahe, formed by Oahe Dam in South Dakota, covers up to 80,000 surface acres in North Dakota, and can store a maximum of 23.1 million AF. The two projects required a total of 550,000 acres of land in North Dakota, including shoreline acres needed for flood conditions.

• Only about 79 miles of the original 350 Missouri River miles in North Dakota remain free flowing.

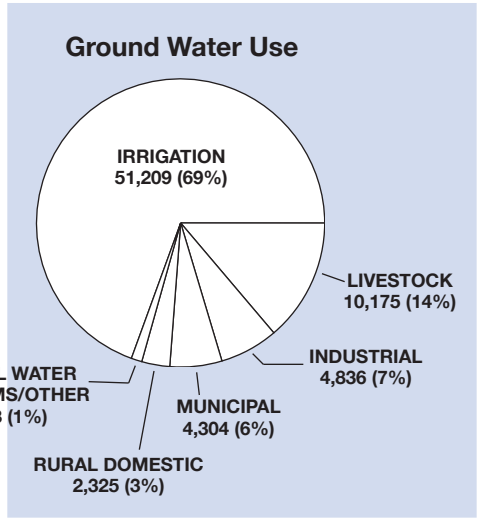
• The Little Missouri River is the only river designated as a State Scenic River by the State Legislature.

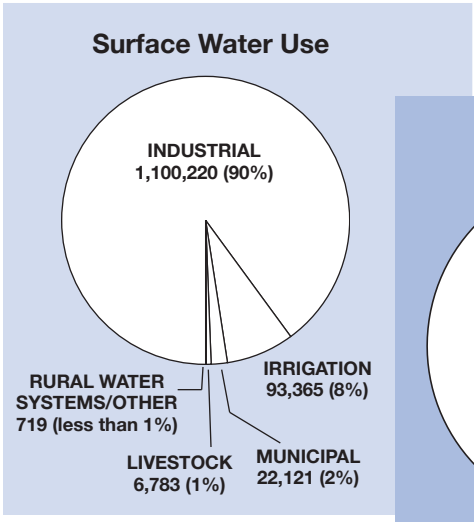
Water Use

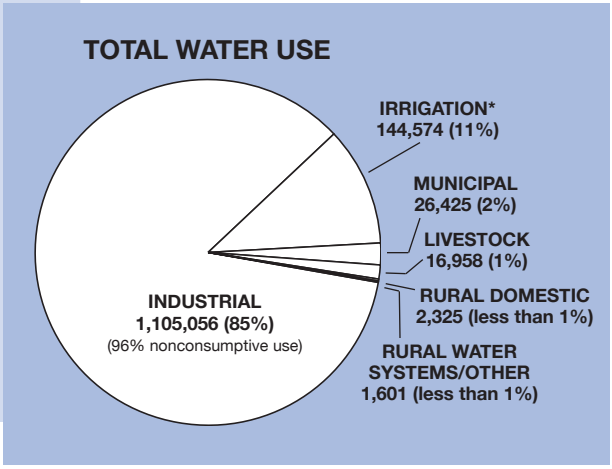
• Eighty-five percent of the water used in the Missouri Basin is used for industry.

• Sixty-nine percent of the ground water used in the basin is for irrigation.

MISSOURI RIVER BASIN
2003 WATER USE
(in acre-feet)







*Includes 26,575 AF of water diverted from the Yellowstone River in Montana to irrigate 17,717 acres of land in North Dakota located along the Montana-North Dakota border.

STREAMFLOW RECORDS OF THE MISSOURI RIVER BASIN

River	Measuring Location	Ave. Daily Discharge	Discharge (CFS) Maximum	Discharge (CFS) Minimum	Annual Runoff (AF)
Missouri	Bismarck[1]	22,680.0	68,800	4,000.0	16,430,000
Yellowstone	Sidney, MT	12,510.0	142,000	570	9,065,000
Little Missouri	Watford City	535.0	55,000	0	387,300
Knife	Hazen	166.0	22,400	0	119,900
Heart	Mandan	262.0	28,400	0	190,200
Cannonball	Breien	241.0	63,100	0	174,500

[1]Records for post-completion of Garrison Dam.

Missouri River Basin Concerns

• Periodic flooding of agricultural land and some communities is a problem in the basin. Communities most seriously affected include Beach, Mott, Williston, Belfield, White Earth, Dickinson, Beulah, and Linton. Rural areas affected include Morton County along the Heart River, and Burleigh County along Apple Creek. In 2004, 37 local governmental entities participate in the NFIP.

• Agriculture, real estate development, and recreational uses are often at odds in the Missouri River corridor. In order to encourage coordinated water and related land resource management and development along the Missouri River, a coalition comprised of local governments and residents of the counties bordering the river has been formed.

• Declining reservoir levels on Lake Sakakawea and Lake Oahe during years of prolonged drought have caused problems for municipal and industrial water supply intakes. Other facilities, such as boat ramps and docks, state parks, and waterfront resorts also can be negatively affected by widely-ranging reservoir water levels.

• Some water users have an inadequate supply of good quality water to meet municipal, rural domestic, irrigation and livestock needs. In 2004, 45 communities exceeded secondary water quality standards. Expansion of rural water systems will improve water quality and quantity for many cities and farms.

• Expected growth in electrical generation facilities fueled by lignite coal will require large amounts of water for processing, and cooling purposes.

• The erosion of topsoil has contributed to sedimentation and the accelerated aging of many reservoirs and lakes in the basin. Examples are Lake Isabel, Lake Hoskins, Yanktonai Dam, Danzig Dam, Green, Brush, and Powers Lakes.

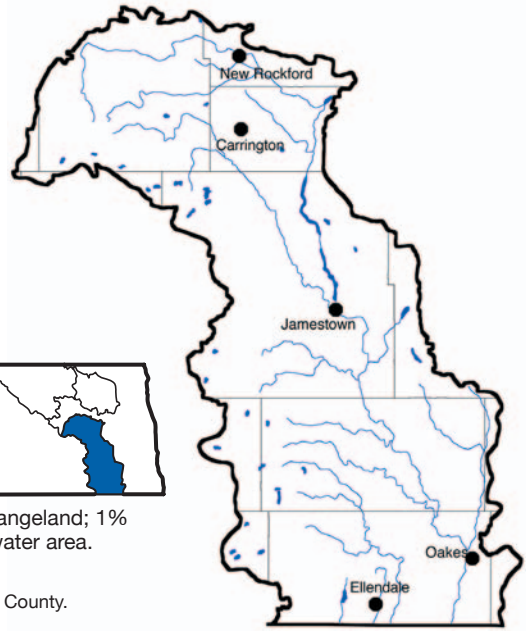
• Many areas of the Missouri River Basin need added and/or improved water-based outdoor recreation facilities.

James River Basin

SUBBASIN OF THE MISSOURI RIVER BASIN

Description

• The James River, a major tributary of the Missouri River, begins in the drift prairie of central North Dakota, but does not join the Missouri until it reaches Yankton, South Dakota. Tributary streams are small, the



POPULATION: 40,467; 69% urban and 31% rural
INCORPORATED COMMUNITIES: 34
DRAINAGE AREA: 6,800 square miles
RESERVOIRS: 90
RESERVOIR NORMAL CAPACITY: 88,519 AF
RESERVOIR MAXIMUM CAPACITY: 645,339 AF
RESERVOIR FISHERIES: 16
NATURAL LAKE FISHERIES: 10
LAND USE: 71% cropland; 7% pastureland; 14% rangeland; 1% forest; 2% urban and built-up; 4% other land; 1% water area.
IRRIGATED ACRES: 31,731*

*Includes 2,582 acres from the Oakes Test Plot in Dickey County.

principal one being Pipestem Creek. The drainage system is poorly to moderately defined, with 56 percent of the basin not contributing to flows in the James River. Countless wetlands store water in the non-contributing portions of the basin. Annual mean precipitation in the basin is 17 inches.

• The James River in North Dakota is 260 miles long.

• Ninety-two percent of the James River Basin is utilized for agricultural purposes.

• Jamestown Reservoir, constructed for flood control and flow regulation purposes, is the largest reservoir in the basin, with a maximum storage capacity of 379,636 AF or 66 percent of the basin's total storage.

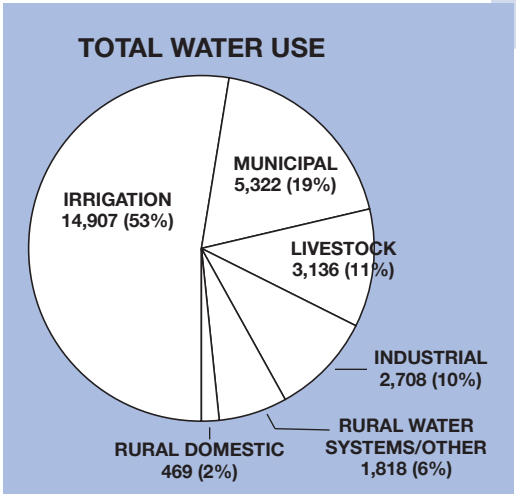
Water Use

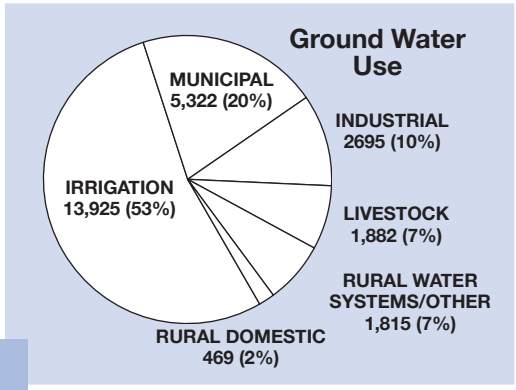
• Of the total water used in the James River Basin, 53 percent is used for irrigation.

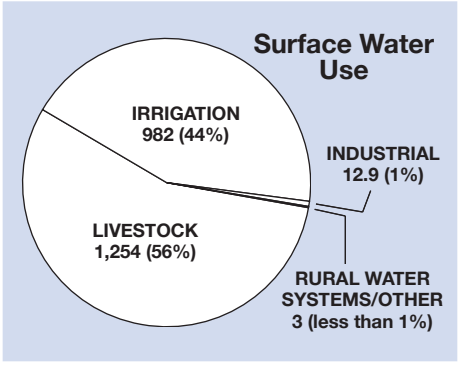
• Fifty-three percent of the ground water used is for irrigation.

• Fifty-six percent of the surface water used is for livestock.

JAMES RIVER BASIN
2003 WATER USE
(in acre-feet)







STREAMFLOW RECORDS OF THE JAMES RIVER BASIN

River	Measuring Location	Ave. Daily Discharge	Discharge (CFS) Maximum	Discharge (CFS) Minimum	Annual Runoff (AF)
James	Grace City	56.7	3,600	0	41,050
James	Jamestown	101.0	6,170	0	73,400
James	LaMoure	163.0	6,420	0	118,000
Pipestem Creek	Pingree	43.9	2,760	0	31,790
Maple	State Line	25.2	5,500	0	18,270

James River Basin Concerns

• The major water problems in the James River Basin relate to periodic flooding of agricultural lands, causing substantial cropland, hayland, and pasture losses, and to periodic flooding of several communities. Communities most severely affected include Jamestown, Spriritwood Lake, Oakes, and Edgeley. In 2004, 18 local governmental entities participate in the NFIP.

• Water quality of the region's streams and lakes is degraded by the sediments and nutrients carried by runoff into the receiving waters. Examples are the James River, Sykeston Dam, Cottonwood Lake, and Whitestone Lake.

• A major issue within the basin is the controversy involving agricultural drainage versus wetland preservation.

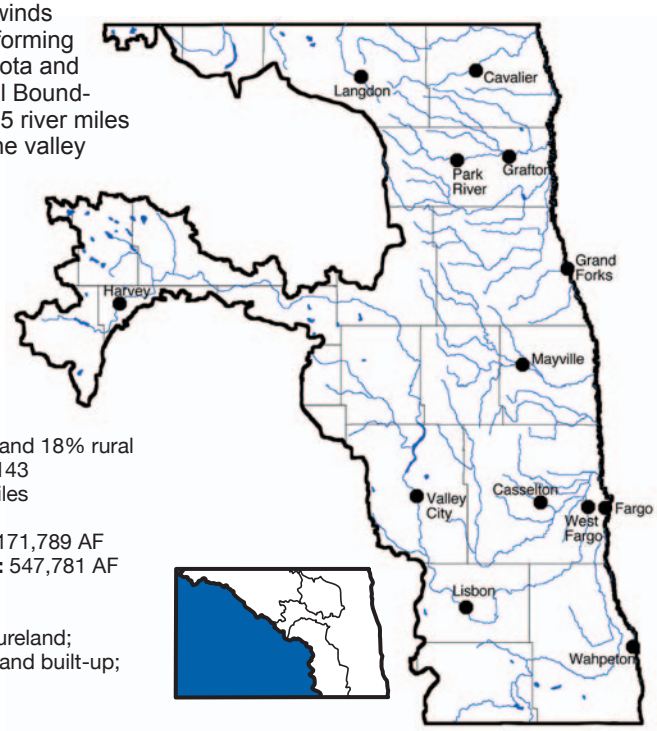
• River channel obstructions and streambank erosion exist in many areas along the course of the James River below Jamestown Dam.

• Many communities and rural areas have water supplies of marginal quality. In 2004, one community exceeded primary water quality standards and 13 communities exceeded secondary water quality standards.

Red River Basin

Description

• The Red River is the principal river of the basin. From its origin at the confluence of the Ottertail and Bois de Sioux Rivers at Wahpeton, North Dakota, and Breckenridge, Minnesota, the Red River winds northerly almost 400 river miles, forming the boundary between North Dakota and Minnesota. From the International Boundary, the Red River flows about 155 river miles to Lake Winnipeg in Manitoba. The valley through which the river flows is actually the bed of glacial Lake Agassiz. The lakebed is very flat and accounts for the meandering course and low gradient of the river. The headwaters of most of the eight major tributaries in North Dakota begin in the drift prairie in the western part of the basin where valleys are narrow and steep-sided. As the tributaries enter the lowlands of the lakebed, the river slopes become very flat, with poorly-defined watershed boundaries.



POPULATION: 279,602; 82% urban and 18% rural
INCORPORATED COMMUNITIES: 143
DRAINAGE AREA: 17,250 square miles
RESERVOIRS: 198
RESERVOIR NORMAL CAPACITY: 171,789 AF
RESERVOIR MAXIMUM CAPACITY: 547,781 AF
RESERVOIR FISHERIES: 31
NATURAL LAKE FISHERIES: 10
LAND USE: 81% cropland; 4% pastureland; 5% rangeland; 2% forest; 3% urban and built-up; 4% other land; 1% water area.
IRRIGATED ACRES: 77,689

Three thousand acres of the basin do not contribute to streamflow. The annual mean precipitation within the basin ranges from 16 inches in the west to more than 20 inches in the southeast.

• The Sheyenne River, a major tributary of the Red River, is 506 miles long, making it the longest river in North Dakota.

• The largest reservoir in the Red River Basin is Lake Ashtabula. This flood control dam is located on the main channel of the Sheyenne River, and has 200,000 AF of maximum storage.

• The Red River is prone to widespread overland flooding. The most recent major flood occurred in 1997, when costs of direct damages, rebuilding, and installation of flood protection measures in the Grand Forks/East Grand Forks area are estimated to be almost $1 billion.

• The Red River Basin has 91 percent of its area devoted to cropland— the highest percentage among the five major basins.

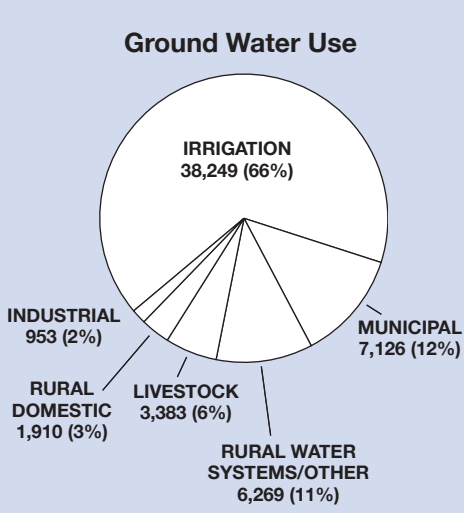
Water Use

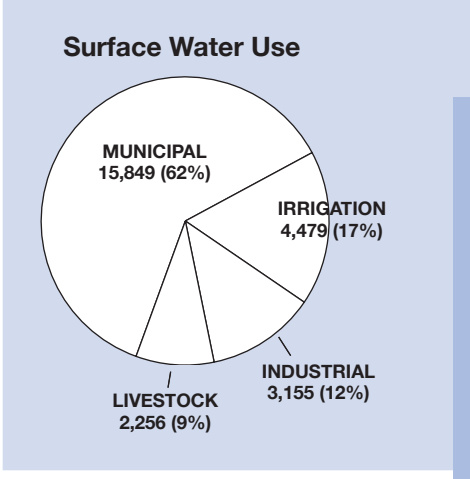
• Irrigators use 51 percent of the total water used in the Red River Basin, making them the major water users.

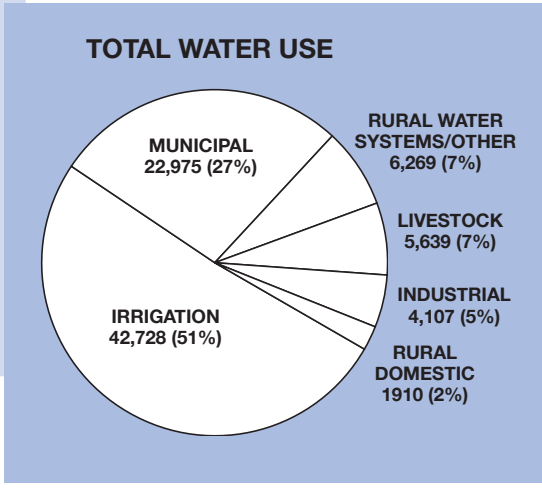
• Sixty-six percent of the ground water used in the basin is for irrigation.

• Sixty-two percent of the surface water used is for municipal purposes.

RED RIVER BASIN
2003 WATER USE
(in acre-feet)







STREAMFLOW RECORDS OF THE RED RIVER BASIN

River	Measuring Location	Ave. Daily Discharge	Discharge (CFS) Maximum	Discharge (CFS) Minimum	Annual Runoff (AF)
Red	Wahpeton	633.0	12,700	1.7	458,500
Wild Rice	Abercrombie	99.6	9,450	0	72,180
Sheyenne	West Fargo	232.0	4,800	1.0	168,100
Goose	Hillsboro	96.7	14,400	0	70,070
Forest	Minto	53.2	11,600	0	38,520
Park	Grafton	62.6	11,700	0	45,340
Pembina	Neche	227.0	14,300	0	164,300

Red River Basin Concerns

• The major problem in the Red River Basin is the destructive, widespread, urban and agricultural flooding created by the Red River and its many tributaries. Because of the mild gradient of the Red River and the nearly level floodplain, flooding along the Red's main stem covers wide areas and can persist for many weeks.

• Communities affected most by flooding include Wahpeton, Valley City, Lisbon, Fargo, Harwood, Grand Forks, Minot, Mayville, Grafton, Drayton, Emerado, Neche, and Pembina. Rural areas near Fargo along the Red and Sheyenne Rivers are also affected by periodic flooding. In 2004, a total of 137 local governments participate in the NFIP.

• Much of the Red River Basin lacks sufficient surface and ground-water supplies to serve growing municipalities and attract new businesses and industries that require large quantities of water. These conditions are especially severe during extended droughts. Water supplies need to be increased by using sources either inside or outside the basin.

• Within the Red River Basin, there is a general shortage of local water-orientated recreation areas.

• Inadequate storage of floodwaters and drainage maintenance are also problems prevalent within the Red River Basin.

• Low stream flows, occurring typically from August through March in the Red River and its tributaries, present a problem to those communities using the water as a municipal water supply.

• Soil erosion is a serious problem, contributing to the loss of valuable topsoil and to the pollution of receiving lakes and streams by sediment and nutrient deposits. Examples are the Red River, Lake Ashtabula, Red Willow Lake, Tolna Dam, Golden Lake, Buffalo Lake, and Mount Carmel Dam.

• Some of the communities and rural areas in the basin have marginal water quality. In 2004, one community exceeded the primary water quality standards, while 49 communities exceeded secondary standards.

• The Red River and many of its tributaries require snagging and clearing of dead trees to improve channel capacity. Most of the problem is caused by Dutch Elm disease.

Devils Lake Basin

SUBBASIN OF THE RED RIVER BASIN

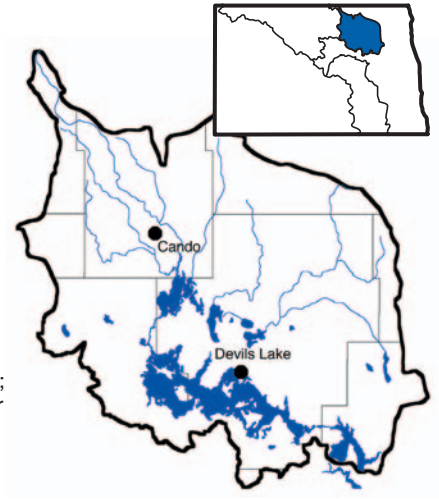
Description

• The Devils Lake Basin is currently a noncontributing subbasin within the Red River drainage basin. The Devils Lake Basin became a closed basin after the last continental ice sheets receded and southerly drainage to the Sheyenne River ceased. The drainage system of the Devils Lake Basin is formed by chains of waterways and connecting lakes, with the majority of the basin's water reaching its ultimate collecting point at Devils Lake. Because of the poorly-defined drainage system, approximately 1,300 square miles do not contribute runoff to Devils Lake.

• Throughout recorded history, the lake level of Devils Lake has fluctuated greatly.The U.S. Geological Survey recorded an elevation of 1438 feet amsl in 1897, after which the level showed a gradual downward trend to a low of 1401 feet amsl in 1940. The trend then reversed, with the lake level reaching 1429 feet amsl in June 1987. The lake declined to elevation 1423 amsl by 1993. A major fish kill was imminent if the lake dropped much lower. True to form, the lake level again reversed, rising 5 feet in 1993 alone. Devils Lake has risen a total of 47 feet from elevation 1401 amsl in 1940, to historic high of 1448 amsl in 2004. As the lake levels change, so do water quality parameters; lower water levels are generally associated with very high total dissolved solids (TDS), and higher levels are associated with a lower levels of TDS.

• A three-pronged approach, which includes basin water management, infrastructure protection, and an outlet to the Sheyenne River is critical to addressing basin water management problems.

• A state sponsored emergency outlet into the Sheyenne River, to help stabilize Devils Lake, is expected to begin operations in 2005.



POPULATION: 23,504; 60% urban and 40% rural
INCORPORATED COMMUNITIES: 28
DRAINAGE AREA: 3,580 square miles
RESERVOIRS: 81
RESERVOIR NORMAL CAPACITY: 49,051 AF
RESERVOIR MAXIMUM CAPACITY: 86,689 AF
RESERVOIR FISHERIES: 1
NATURAL LAKE FISHERIES: 5
LAND USE: 78% cropland; 3% pastureland; 7% rangeland; 2% forest; 3% urban and built-up; 4% other land; 3% water area.
IRRIGATED ACRES: 2,427

STREAMFLOW RECORDS OF THE DEVILS LAKE BASIN

River	Measuring Location	Ave. Daily Discharge	Discharge (CFS) Maximum	Minimum	Annual Runoff (AF)
Mauvais Coulee	Cando	19.7	2,980	0	14,260
Edmore Coulee	Edmore	14.2	1,770	0	10,280
Starkweather Coulee	Webster	12.1	903	0	8,790

• Devils Lake is the largest natural lake in North Dakota, at about 133,000 acres.

• Ninety percent of the basin is used for agricultural purposes.

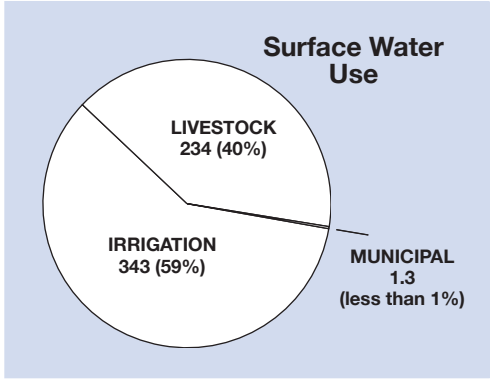
Water Use

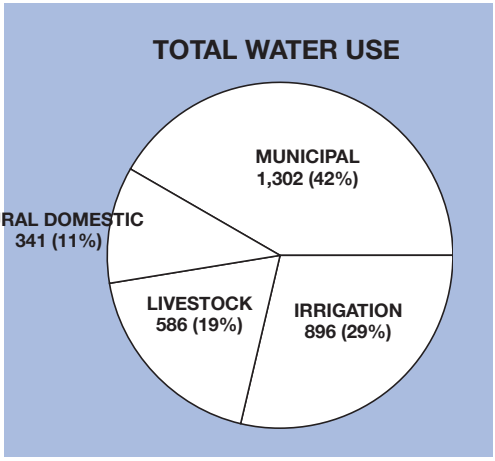
• Water used for municipal purposes represents 42 percent of the Devils Lake Basin's total water use.

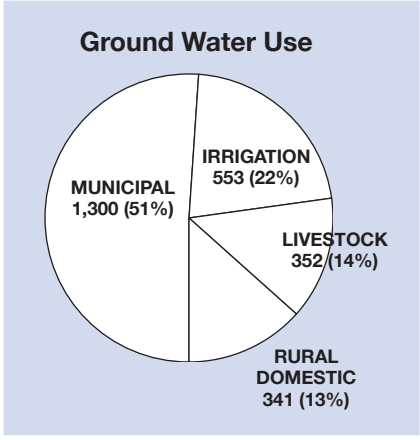
• Fifty-nine percent of surface water used is for irrigation.

• Fifty-one percent of ground water used in the basin is for municipal purposes.

DEVILS LAKE BASIN
2003 WATER USE
(in acre-feet)







Devils Lake Basin Concerns

• Because of poor natural drainage, frequent, overland sheet flooding of agricultural lands and the flooding of some communities are major problems in the Devils Lake Basin. In 2004, six local governments participated in the NFIP.

• The potential increase in Devils Lake's water level presents a flood threat to substantial amount of public, commercial, and private development. The extreme lake fluctuations of Devils Lake impose a serious constraint to additional recreational development, as well as causing serious problems to the fishery. Maintaining a quality fishery with stable lake levels is extremely important to the regional economy.

• Flooded water and sewage lines would be impossible to repair if they were to fail.

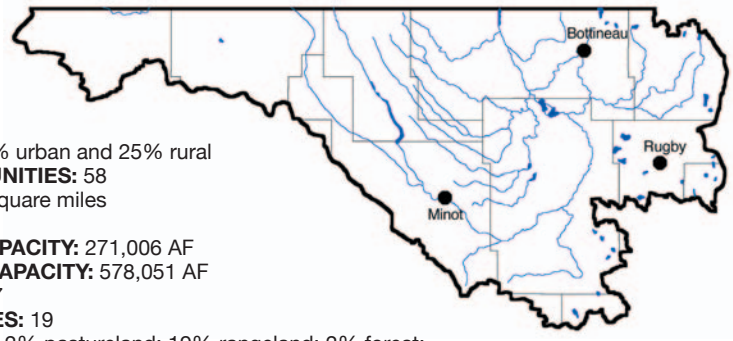
• North Dakota, and the U.S. Government have spent over $450 million in flood mitigation efforts including the raising of roads, railroads, and powerlines, and the building of dikes.

• The city of Churchs Ferry, a grain elevator, and numerous farmsteads and homes have been bought out, evacuated, and either moved or abandoned due to flooding.

• Soil erosion is a serious problem, contributing to sedimentation and nutrient enrichment of area streams and lakes. Examples are Devils Lake and Woods Lake.

• Agricultural drainage versus wetlands preservation is a major concern in the Devils Lake Basin.

Souris River Basin



POPULATION: 88,454; 75% urban and 25% rural
INCORPORATED COMMUNITIES: 58
DRAINAGE AREA: 9,112 square miles
RESERVOIRS: 80
RESERVOIR NORMAL CAPACITY: 271,006 AF
RESERVOIR MAXIMUM CAPACITY: 578,051 AF
RESERVOIR FISHERIES: 7
NATURAL LAKE FISHERIES: 19
LAND USE: 68% cropland; 2% pastureland; 19% rangeland; 2% forest; 3% urban and built-up; 4% other land; 2% water area.
IRRIGATED ACRES: 17,069

Description

• The Souris River originates in Saskatchewan and forms a 357-mile "loop" through North Dakota before it reenters Canada west of the Turtle Mountains. The Souris River drains portions of Saskatchewan, Montana, North Dakota, and Manitoba. There are seven major tributaries in North Dakota; the principal tributary is the Des Lacs River. The drainage within the basin is poorly-integrated, with 2,300 square miles considered noncontributing to streamflow. The topography is varied within the basin, including hilly terrain in the southwest, flat glacial Souris Lake plain in the east, and forested hills of the Turtle Mountains in the northeast. Annual mean precipitation ranges from 13 inches in the west to 17 inches in the east.

• The Upper Souris, J. Clark Salyer, and Des Lacs National Wildlife Refuges are formed by shallow impoundments located

STREAMFLOW RECORDS OF THE SOURIS RIVER BASIN

River	Measuring Location	Ave. Daily Discharge	Discharge (CFS) Maximum	Discharge (CFS) Minimum	Annual Runoff (AF)
Souris	Sherwood	126.0	13,700	0	91,230
Souris	Minot	157.0	11,400	0	113,500
Souris	Westhope	269.0	12,400	0	194,600
Des Lacs	Foxholm	27.4	3,200	0	19,880
Long Creek	Noonan	41.5	5,710	0	30,090
Wintering	Karlsruhe	16.4	2,500	0	11,890
Willow Creek	Willow City	47.9	5,310	0	34,730

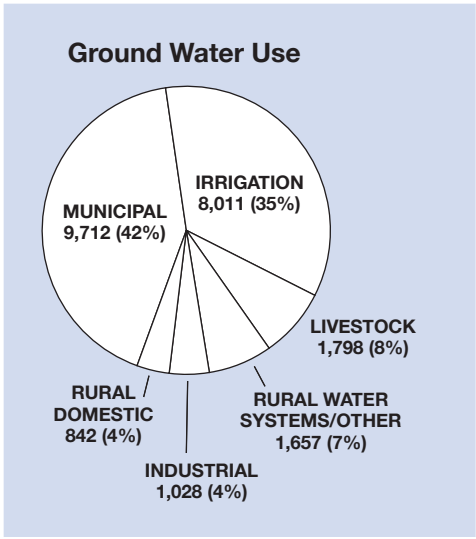
on the Souris and Des Lacs Rivers. The impoundments retain 352,788 AF at maximum storage, equivalent to 88 percent of the total storage in the basin.

Water Use

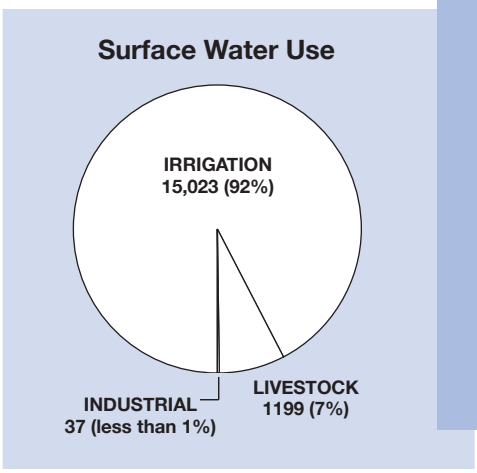
• Irrigation is the major water use in the Souris River Basin, with 59 percent of the total water used.

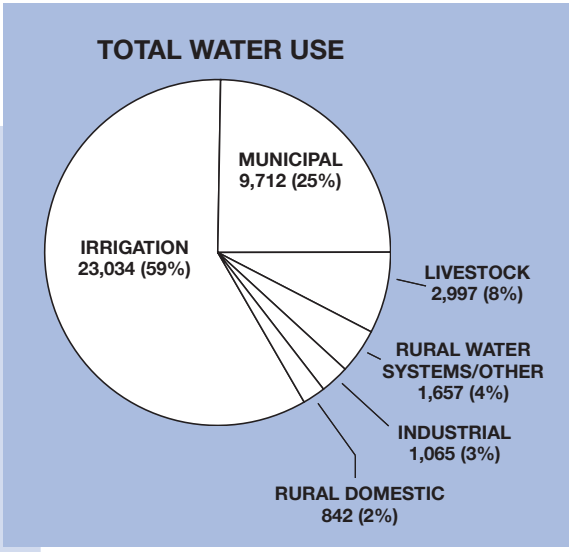
• Ninety-two percent of surface water used in the basin is for irrigation.

• Forty-two percent of the ground water used is for municipal purposes.



SOURIS RIVER BASIN
2003 WATER USE
(in acre-feet)





Souris River Basin Concerns

• Flooding along the Souris River tributaries, including the Des Lacs and Wintering Rivers, and Ox, Oak, Willow, and Stone Creeks, can cause extensive property damage.

• Communities most affected by flooding include Bottineau, Burlington, and Donnybrook. In 2004, 26 local government entities participated in the NFIP.

• A problem within the Souris River Basin is the marginal water quality of some of the area's existing water supplies. Thirty-seven communities exceed secondary water quality standards. Expansion of rural water facilities to new areas will improve water quality in many communities.

• Soil erosion of agricultural lands is caus-

ing degradation of water quality. Examples included Lake Metigoshe, George Lake, Buffalo Lodge Lake, and Balta Dam.

• River channel obstructions and streambank erosion occur in many areas along the Souris River and its tributaries.

• Agricultural drainage versus wetland preservation is a controversial issue in the Souris River Basin.

Water Management in North Dakota

Water management in North Dakota addresses both surface and ground-water problems facing the citizens of the state. Using the combined technical and revenue resources of federal, state and local governments, numerous projects and programs have been and are being developed and constructed throughout the state to deal with the problems of flooding, inadequate water supply, erosion, and the lack of water-based recreation. An example of one of the major cooperative programs is the State Water Commission and U.S. Geological Survey county ground-water studies program. This comprehensive inventory of ground-water resources represents a unique accomplishment, as North Dakota was the first state in the nation to complete such an inventory.

The information and basic data obtained from such hydrologic investigations and data collection programs provide the basis for informed decision-making regarding major water resource issues and problems facing the state.

Water management today represents a cooperative venture between various public entities. Government agencies, including the following, participate to varying degrees in water resource projects and programs:

FEDERAL
Agricultural Research Service
Army Corps of Engineers
Bureau of Land Management
Bureau of Reclamation
Economic Development Administration
Environmental Protection Agency
Farm Service Agency
Federal Emergency Management Agency
Fish and Wildlife Service
Forest Service
Geological Survey
Housing and Urban Development
National Oceanic & Atmospheric Administration
Natural Resources Conservation Service
Rural Develpment

STATE
Agriculture Department
Department of Health
Department of Transportation
Division of Emergency Management
Economic Development & Finance
Extension Service
Forest Service
Game and Fish Department
Garrison Diversion Conservancy District
Geological Survey
Historical Society
Lake Agassiz Water Authority
Land Department
Oil and Gas Division
Parks and Recreation Department
Public Service Commission
Soil Conservation Committee
Southwest Water Authority
Water Commission

LOCAL
County/City Park Boards
County Commissions
County Extension Service
Irrigation Districts
Joint Powers Boards
Municipalities
Water Resource Districts
Weather Modification Authority